"2d. To the bleaching of oils, glycerine, etc.

"3d. To the treatment of oils, to render them siccative.

"4th. To the acetification of alcohols and alcoholic liquors, to transform them into vinegar."

Does not the Eisenmann patent of July 26, 1881, and its addition of Oct. 11, 1881, trespass on the ground of others in claiming a process by ozone and electrolyzation which recalls the prior claims already cited?

The fact is that the good done by ozone to inferior alcohols is more than compensated for later by the production of acetic acid, a phenomenon always produced more or less according to the oxygenizing influence to which the alcohol is submitted.

In conclusion, I propose to you, gentlemen, to give a word of encouragement to the authors of the rectification of alcohol by the cold and electrolyzation methods, and to especially congratulate Mr. Naudin on the important results which he has already obtained in industrial applications.

Paris, Jan. 13, 1862.

SOME OF THE INDUSTRIAL USES OF THE CALCIUM COMPOUNDS.*

By THOMAS BOLAS, F.C.S.

Lecture II.—Delivered November 28, 1881.

LIME.—THE CALCINATION OF THE CARBONATE IN THEORY AND PRACTICE.—INFLUENCE OF FOREIGN BODIES ON THE QUALITY OF THE LIME.—MOST FAVORABLE CONDITIONS FOR THE DECOMPOSITION OF CALCIUM CARBONATE—CEMENTS AND THEIR USES.—LIME AS A REFRACTORY MATERIAL.—LIME-LIGHT.—THE OXYHYDROGEN FURNACE.—LIME MOULDS FOR THE CASTING OF IRON AND STEEL NOTES ON A FEW OF THE INDUSTRIAL AND ECONOMIC USES OF LIME.

JUST a few figures to commence with. The composition of the ordinary carbonate of lime, as represented by chalk, is expressed by the formula:

$$CaCO_3.$$

Ca stands for 40 parts of calcium by weight, C for 12 parts of carbon by weight, and O_3 for three times sixteen, or 48 parts of oxygen. Thus we have:

Calcium	40
Carbon	12
Oxygen	48
	100

These figures when added together make just 100; so that chalk contains 40 per cent. of calcium.

When carbonate of lime is heated to redness under favorable circumstances, the whole of the carbon flies off in company with two-thirds of the oxygen; the gaseous product thus constituted being called carbon dioxide. The whole of the calcium remains behind, united with one-third of the oxygen, this compound being ordinary lime. In symbolic language the decomposition is thus represented:

$$CaCO_3 = CaO + CO_2.$$

These symbols imply that 100 parts by weight of calcium carbonate split up into 56 parts of lime and 44 parts of carbon dioxide. Although the diminution of weight which a limestone undergoes when burned is 44 per cent. or more, as moisture and organic matters are often present, the reduction as regards volume is much less—say some 14 to 25 per cent.

Here is a small fragment of carbonate of lime in the form of marble. You see that the heat of this blow-pipe is directed on it for a few seconds only; but this suffices to effect the decomposition of a considerable proportion of the carbonate, so that when it is placed on a sheet of damp and strongly colored red litmus paper, a vigorous blue coloration is immediately formed round the material. Although the carbonate of lime is so readily decomposed by heat under these circumstances, it is quite possible to expose it to an equally high temperature without decomposition occurring to a notable extent. If carbonate of lime is heated to redness in a closed iron tube, it simply fuses, and on cooling it solidifies to a semi-crystalline mass, like marble. If it is heated under the ordinary atmospheric pressure, the decomposition is extremely slow, unless the carbon dioxide first liberated is removed by some means. This last fact is very well illustrated by an experiment which it will be easy to show you. Here is an iron tube which passes through one of Mr. Fletcher's new gas furnaces for heating tubes, and this tube is packed tolerably full of fragments of marble. In a few minutes the tube will be heated to bright redness, and you will notice that the evolution of carbon dioxide, as measured by the occasional bubbles which pass into the gas jar, is extremely slow. Notice now the effect of passing steam over the heated carbonate of lime. A rapid evolution of carbon dioxide takes place, and the receiving jar is almost immediately filled with the gas. A stream of air, or other gaseous matter, will produce a similar effect, but steam is most notably effective in expediting the decomposition of heated carbonate of lime into lime and carbon dioxide. In a similar way, the decomposition may be facilitated by a reduction of the pressure; as, for example, when the liberated carbon dioxide is continually removed by means of an air-pump.

A very high temperature is not by any means necessary for effecting the thorough decomposition of carbonate of lime; a moderate red heat being quite sufficient, if other conditions are favorable. A moderately rapid current of steam may be considered to reduce the time necessary for the decomposition to one-eighth, and a knowledge of this fact has led some to suppose that a notable advantage is gained by the burning of damp limestone. This supposition seems, however, to be unfounded, as one may readily believe when it is borne in mind that the greater part, if not the whole, of the water must be driven off long before the heat required for effecting the decomposition of the carbonate is reached. It appears, however, an advantage to place water-troughs in the air-ways of the furnaces in which lime is burnt. In connection with this point, it must not be forgotten that such fuels as wood and coal contain a notable portion of hydrogen, and when this burns water is formed.

In some cases, as when the limestone is contaminated with a considerable proportion of clay, sand, oxide of iron, or alkaline bodies, it is desirable to take advantage of every circumstance which can facilitate decomposition, as an elevated temperature would cause a partial vitrifaction of the lime, owing to its chemical union with the above-mentioned foreign bodies. Sometimes it happens that a sudden elevation of temperature will melt the surface only of the lumps of partially-burnt lime, and, as it were, glaze them over, and thus protect them from further decomposition, while in other cases the vitrifaction may occur all through the lumps. This vitrified lime will not slake at all, or will only slake imperfectly; but for all that it may, if finely ground, form an excellent hydraulic lime or cement; or if mixed with a considerable proportion of a rich or "fat" lime, it may confer hydraulic properties on it. If the heat has been insufficient, so that the whole of the carbon dioxide has not been driven off, each lump of lime will include a kernel, containing a large proportion of the orthocarbonate Ca_2CO_4. Such imperfectly burned lime will not slake on the addition of water, if it consists mainly of the orthocarbonate; but if ground and mixed with water, it will slowly set, without having much tendency to crack.

These considerations will indicate the propriety of placing the small lumps of limestone, or the least pure varieties, toward the top of the furnace, or near the edges, while the large lumps of the purer stone may be placed where the heat is likely to be greatest. This remark only applies to a periodical furnace, which is burned out before being recharged. The heat advisable in ordinary cases may range from 700° to 1,000° Centigrade, according to the quality of the stone.

Your attention will next be called to some diagrams of the various classes of lime furnace in use. The drawing which is now projected on the screen represents one of the most primitive lime furnaces, but a form still in actual use. It consists merely of a dome-shaped heap, which is 15 or 18 feet across, and is built up of alternate layers of fuel and limestone, and covered with loam, excepting the extreme top and an opening at the bottom, which leads into a tunnel-shaped channel, leading across the bottom of the heap. Although this primitive lime furnace is very wasteful as regards fuel, there are occasions when it is the most convenient arrangement for burning lime.

The next lantern slide represents a rudimentary shaft furnace, and, in most cases, such a furnace is excavated out of the limestone rock itself. It consists of a cylindrical shaft about 14 feet in diameter and about one and a half times as deep, a small horizontal channel serving to admit air; and a dome of limestone is generally built round about the place where the horizontal channel opens into the shaft, so as to allow an approximately equal distribution of the heat. This form of furnace works very satisfactorily, if carefully managed, and very many of them are in regular use all over the country. Those of you who travel on the South-Eastern Railway toward Woolwich may see one by looking out of the right-hand window of the train, just after it has passed Westcombe Park station. The next slides represent improvements on the simple shaft furnace, a fire-brick lining being introduced, the mouth being somewhat contracted; while methods of inserting sticks of wood, so as to lead the draught equally through the various parts of the mass, are shown. The diagram now before you shows another step in advance, a grate of fire-bars being introduced, and a permanent arch of firestone, or other refractory material, instead of the temporary arch built out of the limestone itself. Many forms of interest must be passed over without consideration, in order that you may be enabled to study those furnaces which are continuous in their action, that is to say, are kept constantly burning, fuel and fresh limestone being added at the top, and the burned lime removed at the lower part, without extinguishing the fire. In the case of the furnace now represented on the screen, you will notice the damping arrangement for stopping the draught at the time of extracting the burned lime, the hot lime being raked into the cooling chambers, which are provided with ventilating shafts, in order to facilitate the operation.

It is probable that a notable future is before the process of burning lime by means of gaseous fuel, generated by such an apparatus as that of Siemens, especially when this method is carried out in conjunction with the principle of the ring-furnace, or annular kiln, next to be described.

The annular kiln will become intelligible to you by a study of the diagram which Mr. Barker will next project on the screen. In kilns of this description the fire-chamber may be regarded as a ring or closed circuit, placed in a horizontal position; but this ring need not be round, it being more usually formed like an oblong with rounded corners. The fire-channel or ring may be regarded as being built up of a number of segments, and a cut-off or damper may be inserted between any two of these segments. Each segment has a direct connection with the main chimney; which can, however, be cut off by means of a metal bell, which drips into a ring-shaped vessel containing sand, a form of joint which is extremely useful in furnace work. Each segment can also be opened so as to admit the external air or limestone; and fuel is added through small holes in the top of the ring-system.

Now imagine that one of the dampers or diaphragms is inserted between two of the segments so as to block the ring at that point, and that the segment on one side of the damper, say the right-hand, is open to the air, while that at the other side is connected with the chimney. If the fire is now lighted at the open segment, the flame or heated air will have to circulate round the ring until it reaches the adjacent segment, or that on the other side of the damper, before it can reach the chimney. Things being allowed to go on, a period is arrived at when the maximum of combustion is seated at a point midway in the circuit, or opposite the damper. When this is the case, the segment where the fire first began is emptied of its lime, and fresh limestone put in; while at the same time the damper is shifted, so as to add this segment to the unburned end of the series, the chimney being then connected with it, and the air-way of the next segment on the right is opened. By proceeding in this way, the point of maximum combustion can be kept nearly opposite the diaphragm, or damper, and that air which actuates the furnace becomes considerably heated in its passage over that lime which is already burned, while the waste gases impart a considerable proportion of their waste heat to that material which has not yet commenced to burn.

The waste of heat is so small in a well constructed annular kiln, that in some cases as little as seven per cent. of fuel is used; and, moreover, the labor involved in working the furnace is not very considerable. Several thousand furnaces are in use at the present time, and whenever the operation of lime or cement burning is performed on a large scale, it is likely that this system will come into use, either with solid or with gaseous fuel. It is not at all necessary that the shaft or chimney should be built in the middle of the ring system, as represented in the diagram now on the screen; only when it is outside, some of the chimney channels must be a little longer.

If one wishes to increase the turnout of a ring-furnace, it is merely necessary to use two dampers, and keep each half of the furnace in independent action, but in such a case the air passes over a less length of finished lime, and the products of combustion are less perfectly denuded of their surplus heat, by reason of the shorter length of unburned material over which they pass; there is, therefore, less economy of fuel than when one fire is kept burning in each furnace. If the ring, or annular channel, is made long enough, there is no reason why several fires should not be kept in circulation.

Well, now, lime is a compound of oxygen and calcium; but besides this normal oxide of calcium there is another oxide which contains double the proportion of oxygen. This is, however, a very unstable body, which is of no particular interest out of the laboratory.

One of the most notable properties of lime is its extreme power of resisting the fusing action of fire, the intense heat of the electric arc only serving slightly to soften it. This infusibility is taken advantage of in the lime furnace of Deville; this apparatus being used for melting platinum and other highly infusible metals. Here is a small one which will serve for melting half an ounce of platinum. The metal is placed in the hollow of the lower block, and the flame of a powerful oxyhydrogen blow-pipe is made to enter at the top, as you now see. You notice how the incandescent lime glows, this glow being the well-known lime light. Here is one of the usual arrangements for producing this light. A jet of coal gas is crossed by a fine stream of oxygen, and the sharp and bluish flame is allowed to impinge on a small cylinder of quick-lime; this becoming incandescent almost immediately, and giving out the brilliant light which you now see. The lime light is being used in this magic-lantern for projecting the photographic reductions of diagrams on the screen; and as the light in question is highly actinic, it is of frequent use in many photographic operations, and notably in making enlargements. It is very probable that, before long, the lime-light may compete with the electric light for the illumination of large buildings and open places.

Iron and steel may be satisfactorily cast in lime moulds. Here are some specimens which were poured into the moulds just at the commencement of the lecture, and if you will pass them round you can try them with this file. Certain continental engineering firms make considerable use of lime moulds for steel, and these moulds may either be cut out of blocks of lime, or they may be made, like ordinary moulds, out of a mixture of tar varnish and powdered lime. In any case they should be heated to a low red heat before the metal is poured in.

The Gilchrist-Thomas process for the dephosphorization of iron is well known to you; the converter being lined with lime bricks, which take up the phosphorus during the operation of "blowing." One of the bricks used is on the table, and you can examine it for yourselves. It is coated externally with pitch as a protection against the atmosphere.

When lime is brought into contact with water, combination soon ensues, and heat is evolved; a white powder containing CaH_2O_2, and commonly known as slaked lime, being the result. The heat evolved by the slaking of lime has been known to cause fires, and one occasionally sees workmen cooking breakfast or dinner by the heat of a heap of slaking lime.

When lime is freely exposed to the air, it soon absorbs enough water to become slaked, but at the same time it absorbs carbonic anhydride, and is partially converted into orthocarbonate, $Ca_2CO_4 + xH_2O$, a substance which is excellently well adapted for making mortar.

Lime dissolves in about 800 parts of cold water, but is somewhat less soluble in hot water, so that when this clear lime water is boiled, it will deposit a portion of its lime.

The principal use of lime is for making mortar, and in this case sand is used, not only to prevent the cracking which would happen if a mere paste of lime and water were used, but also to unite chemically with a portion of the lime, a layer of true silicate of lime being formed round each grain of sand. The conversion of the lime into carbonate takes place with extreme slowness, and appears to play a secondary part in relation to the hardening process, as samples of mortar taken from the Great Pyramid in Egypt were found to contain free lime.

The presence in lime of certain foreign bodies, as clay, oxide of iron, silica, or manganese oxide, exercises a remarkable influence on the properties of mortar made with it, such mortar possessing, in a degree depending on many circumstances, the property of setting under water. Such a lime is ordinarily called hydraulic lime.

At Puzzuoli, in Italy, a remarkable volcanic product, called puzzolana, is found, this material consisting principally of silicates of calcium, aluminum, and sodium. When this puzzolana is intimately mixed with an ordinary or "fat" lime, hydraulic mortar or cement is obtained which possesses most valuable qualities, and has satisfactorily resisted the destructive tendencies of two thousand years.

The mineral known as trass, and which not only is found abundantly on the banks of the Rhine, but also occurs in Ireland, is an analogous substance, and it is largely used in some parts of Germany and in Holland for making hydraulic mortar. Finely powdered silica, glass, or lightly burned clay in a state of minute division, possesses similar properties; but in the present day hydraulic cements are mostly obtained either by the careful calcination of impure limestones, as found in nature, or by the use of artificial mixtures—say of chalk and clay—made up to the required composition.

Enormous quantities of the so-called Portland cement are now manufactured in this and other countries, by mixing chalk with river mud; and, after the mass has dried, burning until incipient vitrification sets in. The mass, being now finely ground, forms an admirable hydraulic mortar when mixed with water and sand. Before you are samples illustrating the manufacture of Portland cement, which have been supplied by Messrs. White Bros. and Messrs. Francis & Son. It is not necessary for me to enter into any detailed description of the Portland cement manufacture, as this would require a course of lectures by itself, and you can study it up for yourselves, by means of Mr. Reid's useful manual on this subject and also his work on concrete.

The cement ordinarily called "Roman," is made from the nodules of highly ferruginous and very impure limestone, known as septaria, which are found in the Thames Valley, and it sets with great rapidity. Messrs. Francis & Son manufacture a similar article from the medina earth, which sets more rapidly than the ordinary Roman cement. They were kind enough to send me a small cask as a sample. A part of this was put to a practical test, by being used to mend a leak in the roof of my house, and the remainder is before you. Mr. Barker is now mixing some with water, and you

* Four lectures delivered before the Society of Arts, London. Lecture I. in SUPPLEMENT, No. 327.

will have an opportunity of seeing for yourselves how rapidly and firmly it sets.

Little can now be said as regards concrete, for the reasons already given, but a few illustrations of the admirable materials obtained by incorporating Portland cement, a hard material such as small stones, and water, are before you. The specimens lent by Mr. Lascelles, of Bunhill Row, illustrate his ingenious and quickly executed system of building with slabs made of concrete, and the models on yonder side of the room show his method of mounting the slabs or blocks. A book of designs by Mr. Norman Shaw illustrates well the capabilities of Mr. Lascelles' system. One of these designs has been photographed as a lantern slide, and will be shown on the screen by Mr. Barker. It is surprising what a variety of things can be made of Portland cement concrete—even tables, chairs, and casks have been made successfully, but all are subject to the drawback of being rather heavy.

Here are some fine examples of artistic casting in Portland cement, which have been executed by Messrs. C. H. & T. Mabey. Mr. Lascelles has also sent samples of finely moulded window dressings and other decorative articles.

In connection with the subject of concrete, it is necessary to allude to the so-called patent Victoria stone, a material which seems likely to take a very high place among artificial stones. It consists in the main of a Portland cement concrete, the aggregate consisting of granite chips. When the material is set, it is soaked in a solution of sodium silicate, which hardens it so much that, as regards strength and durability, it stands almost as high as granite itself.

Some artificial stones made according to Ransome's system are on the table. In this case sand, or pure silica, is cemented together by a strong solution of sodium silicate, and the articles are next hardened by a bath of calcium chloride. These stones are of especial value to making grindstones, sharpening blocks, and filtering slabs of vessels; uses which are illustrated by samples on the side table. Messrs. Ransome & Co. also make use of the silicate of soda and chloride of calcium solutions for rendering soft brickwork or stonework impervious to damp; the liquids being applied alternately; and their value for this purpose is well illustrated by this brick, one-half of which has been treated. Although there is scarcely any difference as regards the appearance of the two halves, you see that water is readily absorbed by the untreated half, but not by the portion which has been rendered impervious by the solutions of Messrs. Ransome & Co.

The dephosphorizing properties of lime have been rendered available in obtaining compact masses of the refractory metal, iridium; the spongy metal being first fused with a moderate proportion of phosphorus, after which the comparatively fusible phosphide is heated in powdered lime, until all the phosphorus becomes removed.

As an indirect manure, lime possesses some value, decomposing silicates, disintegrating organic matter, and destroying insects. As an agent in various chemical industries, lime holds an important position; its uses in tanning, the preparation of the caustic alkalies, the liberation of ammonia, and other processes, being very considerable. With respect to its bearing on the iron industry, my remarks must be deferred until the utilization of the furnace slag is considered. Some kinds of glass, as for example the hard Bohemian variety, contain a considerable proportion of lime; and powdered lime is often used in packing delicate articles of steel which it is undesirable to oil. In this case it most effectually prevents rusting.

[FROM THE AMERICAN MEDICAL WEEKLY.]

CEREAL FOODS.

HIGHLY IMPORTANT AND EXTENSIVELY ADVERTISED CEREAL FOODS UNDER THE MICROSCOPE.—THE GENUINE; THE SPURIOUS; THE WORTHLESS, AND THE FRAUDULENT.—THERAPEUTIC AS WELL AS DIETETIC FACTS OF GREAT VALUE TO PHYSICIANS AND THEIR PATIENTS.

By EPHRAIM CUTTER, A. M., M.D., Harvard, and University of Pennsylvania.

Author of Boylston Prize Essay, 1857; Delegate from Mass. Med. Soc. to U. S. Pharmacopœia Convention, 1860; Hon. Mem. California and New Hampshire State Medical Societies; Associate Member Philosophical Society of Great Britain and of the Société de Microscopie Belgique; Principal Med. Dept. Am. Institute of Micrology; Author of "The Clinical Microscope," and "Introduction to the Use of the Microscope," and of many medical and scientific papers, etc., etc., etc.*

The great difference existing in the character and quality of cereal foods (wheat, corn, oats, rye, and barley), offered for sale, has attracted the attention of all close observers. Some of these advertised "foods" are perfect and genuine; some are defective and injurious; while many are worthless in composition, and even fraudulent in preparation.

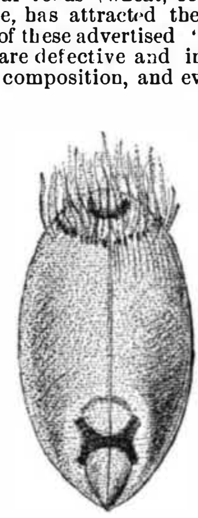

FIG. 1.

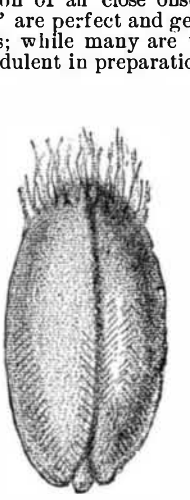

FIG. 2.

These demonstrable facts are highly important, of course, to physicians, who use such foods so largely and so well in the treatment of many diseases: but they are of equal importance to the members of every community: to mothers who, above all, are chiefly charged with the responsibility of the diet of their children, and especially of those undergoing the suffering and dangers of teething; to fathers who, however busily engaged, are deeply interested in the safety and comfort of their families; and to the millions who, suffering from indigestion and dyspepsia, seek anxiously for relief and cure by the use of foods best adapted for their condition. To all of these, the truth in regard to foods, as revealed by that unerring teacher, the microscope, must be vitally important and interesting.

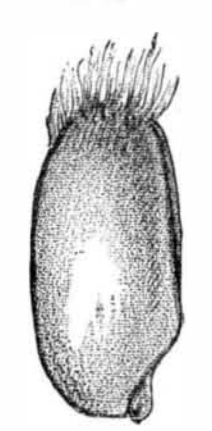

FIG. 3

Fully appreciating the great importance of having demonstrated, to the public, the unquestionable truth in regard to the exact value of cereal foods, showing which foods are genuine and which defective, Dr. E. S. Gaillard (of this city) the editor of *Gaillard's Medical Journal*, and of the *American Medical Weekly*, requested me to examine, microscopically, all of these foods, and to report the results for publication. This request was made in April, 1881, and the examinations described have been carefully made during the

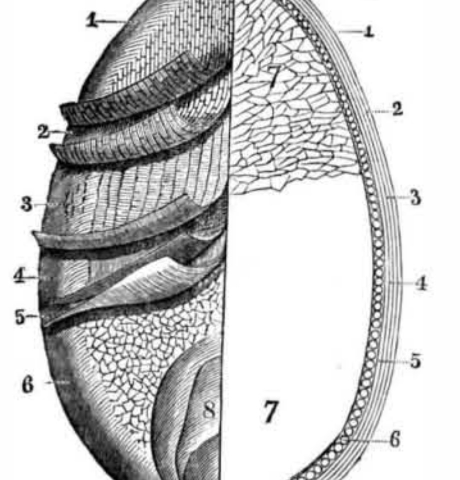

FIG. 4.—AFTER HAND.

eight months which have since elapsed. The examinations were made by me personally, and the microscopic drawings were made in my office and under my supervision, by Dr. A. T. Cuzner, of this city, one of the most competent, faithful, and skilled artists in this department of scientific art. The drawings prepared by him were photographed on the plates used in these illustrations by the Moss Photo-engraving Company, New York, and the results are all herewith presented.

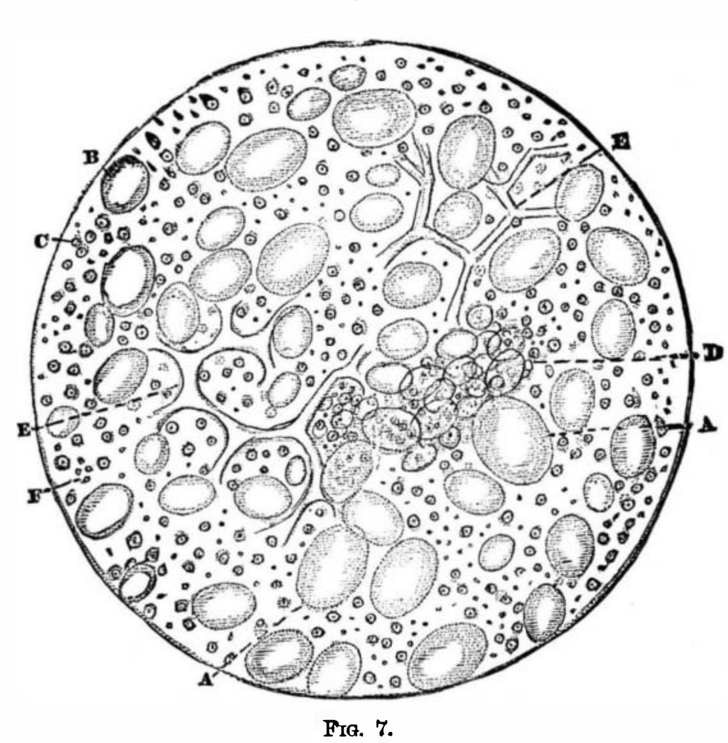

FIG. 7.

All cereal foods (wheat, oats, corn, rye, and barley) contain almost exclusively gluten and starch.

Gluten is the viscid, tenacious substance of dough, and in addition to its highly valuable nutritious property, is essential in all panification or bread making. Gluten, says Magendie, the immortal French physiologist, "by itself secures complete and prolonged nutrition." Pereira, the great authority, says "gluten is easy of digestion, and substances which contain it largely are readily digested even by invalids and dyspeptics. It is alone capable of securing prolonged nutrition."

Starch is too well known to need description. "It is in capable alone of sustaining life."

If a grain of wheat, as a type of other cereals, be examined there will be found, first, the outer, middle, and inner coats, forming together the husk or bran; these coats are wholly destitute of nutritious properties. Next in order comes a layer of cells, or sacs, crowded together and lying in irregular shapes; these sacs averaging one six-hundred-and-seventy-fifth

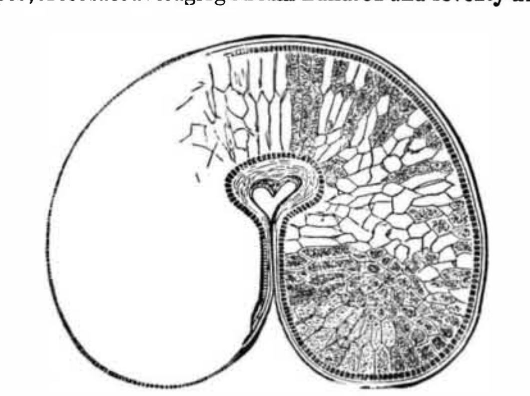

FIG. 5.—AFTER HAND.

of an inch in diameter, contain gluten, with a little oil and albumen. The gluten is in the form of mall granules, one fifteen-hundredth of an inch in diameter, and when a sac is ruptured, these adhere to each other (a e glued together) with great tenacity. Lastly, in the ce iter of the grain, packed away in cells or sacs, is the st rch, also in small granules. These sacs or cells are in the form of oval globules, and, when ruptured, as is done by boiling or cooking, the inside contents escape, forming a glutinous mass, in which, under the microscope, are seen the broken sac membranes in crescentic and irregular shapes.

These grains, with the coats and cells or sacs, are accurately given in Figures 1, 2, 3, 4, 5, and 6.

The reader has here a clear insight into the rationale and the reliability of the examination of cereals under the microscope.

The foods examined and described are as follows: 1, com-

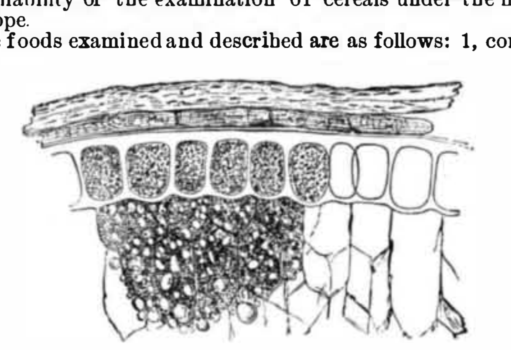

FIG. 6 —AFTER HAND.

mon flour; 2, imperial granum; 3, Ridge's food; 4, Horlick's food; 5, Mellin's food; 6, gluten flour; 7, Franklin Mills entire wheat flour; 8, Arlington wheat meal; 9, Crosby's food; 10, Blanchard's No. 1 gluten; 11, Blair's wheat food; 12, Nestle's milk food; 13, baby sop, No. 1; 14, baby sop, No. 2; 15, Redmond's cerealine; 16, Anglo-Swiss milk food; 17, Durkee's glutena; 18, Farwell's gluten flour; 19, Victor's baby food; 20, Bermuda arrow root, from the plant; Taylor Brothers, London, pure Bermuda arrow root; 22, Minnesota surprise flour (new process); 23, trade dollar process flour; 24, Hubbell's prepared wheat; 25, mother's cereal milk substitute; 26 Hawley's Liebig's food; 27, papoma; 28, Gerber's food for infants and children; 29, Gerber's milk food; 30, cold blast flour, extra, New York Health Food Co.; 31, barley flour, extra, New York Health Food Co.; 32, buckwheat flour; 33, indian wheat flour; 34, Lost Nation wheat flour; 35, Corinna wheat flour; 36, St. Paul wheat flour; 37, Hazleton wheat flour; 38, Puritan wheat flour; 39, Patapsco wheat flour; 40, Underwood wheat flour; 41, fine granulated wheat flour; 42, cold blast whole wheat dark flour; 43, crude gluten flour; 44, white gluten flour.

Do these foods sustain their claims?

Figures 1, 2, and 3 represent a grain of wheat. Note the beard, the longitudinal groove, and the germ.

Fig. 4. This figure is from Horsford's report on bread at the Vienna Exposition. It represents a longitudinal section

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We are requested by Dr. E. S. Gaillard to state that Figures 4, 5, 6 and 8 were not prepared for his Journal but are the original cuts used in the Horsford Report on Bread, at the Vienna Exposition; these cuts being kindly placed at his service by Mr T. J. Hand, of this city, to whom the public is indebted for their execution. By an accidental omission, much regretted, these facts were not stated in the *American Medical Weekly*.

of a grain of wheat: 1, outer coat; 2, middle coat; 3, inner coat; 4, color coat; 5, gluten coat; 6, gluten cells; 7, parenchyma, or starch mass; 8, the germ.

Fig. 5. This figure represents a transverse section of a grain of wheat. Note the different coats: the envelope coats; the gluten coat (dotted), and the starch masses within.

Fig. 6 Portion of a transverse section of a grain of wheat; shows empty and filled gluten cells; starch masses in the interior, with the tough, fibrous connective tissue. The reader should learn here to identify the large gluten cells, empty and filled, forming the third coat. The shape of these cells should be remembered, for it is upon the gluten in cereal foods that their chief value depends.

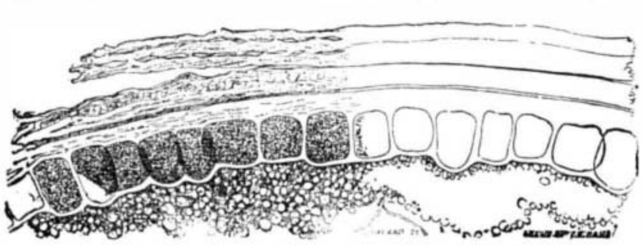

Fig. 8.—AFTER HAND.

Fig. 7. Common wheat flour, magnified 800 times.—A, giant starch cells; B, medium starch cells; C, starch granules, aleurone (or farina), and granular gluten from ruptured gluten cells; D, starch bundles and fibrous tissue; E, fibrous tissue. There are no gluten cells, these being ruptured, liberating the granules of gluten. *In making flour, three fourths of the gluten is removed, and the chief strength of the food is thus destroyed.*

Fig. 8. Transverse section of a scale of bran, magnified 150 diameters. This bran is removed to make flour white, and this removal is the cause of the loss of three-fourths of the gluten. Note the gluten cells, thickly packed away in the bran. The removal of the bran, it is thus demonstrated, is the removal of the gluten.

Fig. 9. The Imperial Granum Food.—This food is represented to be gluten from white, winter, flint wheat; the starch, impurities, and soluble matter effectually excluded, the gluten only retained, etc. There are no gluten cells visible. Note the giant starch grains, A; B, granules of starch and aleurone; C, connective tissue; D, granular gluten. I have always failed to find gluten cells. *It ranks only with common flour.*

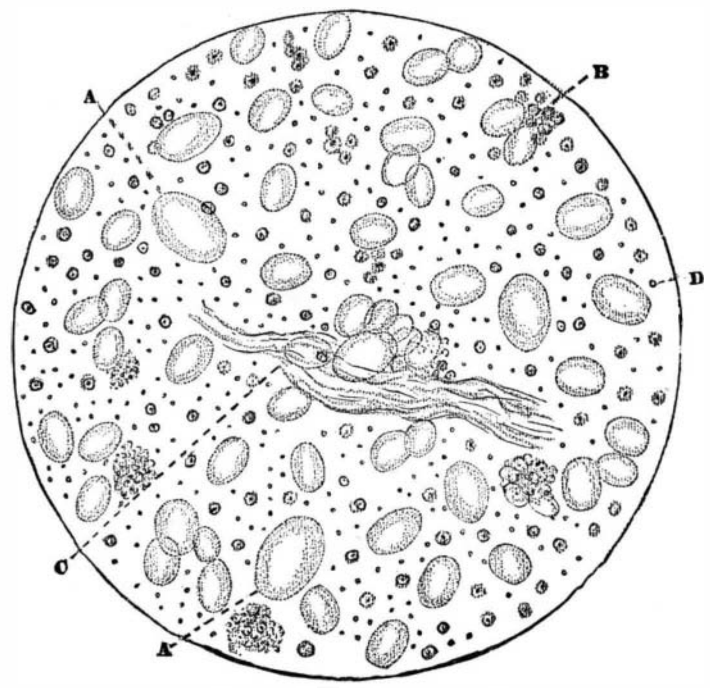

Fig. 9.—IMPERIAL GRANUM.

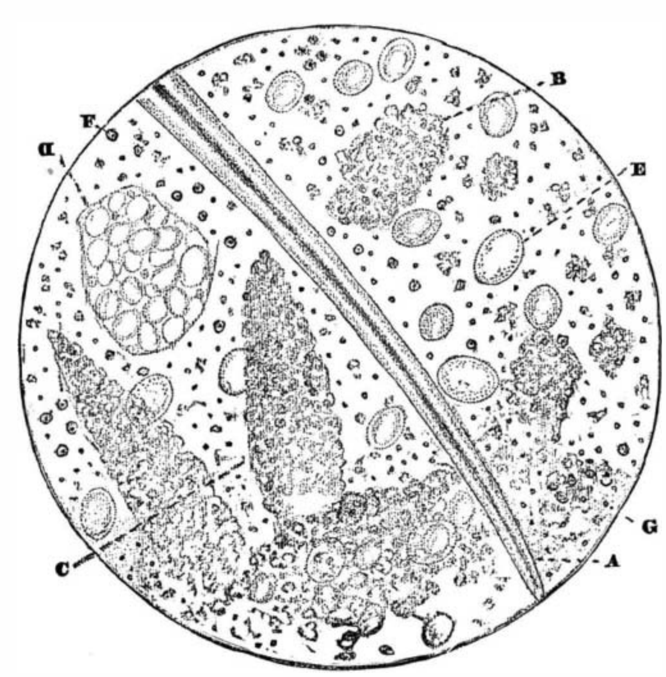

Fig. 10.—RIDGE'S FOOD.

Fig. 10 Ridge's Food, magnified 800 times.—It is claimed to be "a perfect food for infants." It contains no gluten cells. Observe the beard of the wheat at A; B, wheat starch mass; C, starch bundles, apparently of maize; D, cooked mass of starch, which does not polarize light; E. starch grains; F, starch granules; G, small gluten granules. *The proprietors must add gluten cells, at least in the proportion found in wheat or maize, to bring their product up to the standard of wheat flour.*

Fig. 11. Horlick's Food, magnified 800 diameters. The starch that makes up the bulk of the food is changed into dextrine, or sugar, hence it is soluble. A, cooked, vegetable granular mass; B, hair of wheat; C, empty and filled gluten cells, found only after a long search through several specimens. The dark unsightly masses are portions of cooked material, that have no effect on polarized light. Claims "to be a perfect food for infants." *It approaches common flour.*

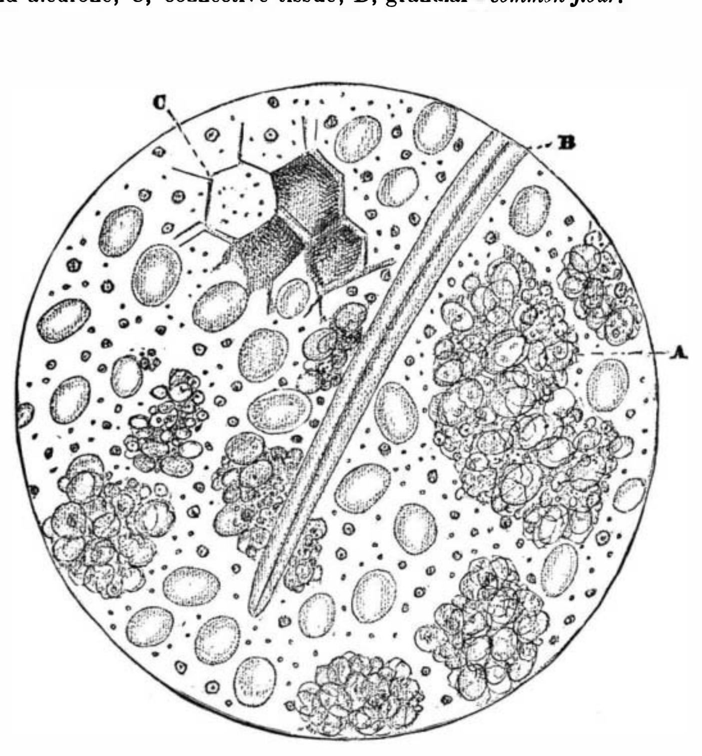

Fig. 11.—HORLICK'S FOOD.

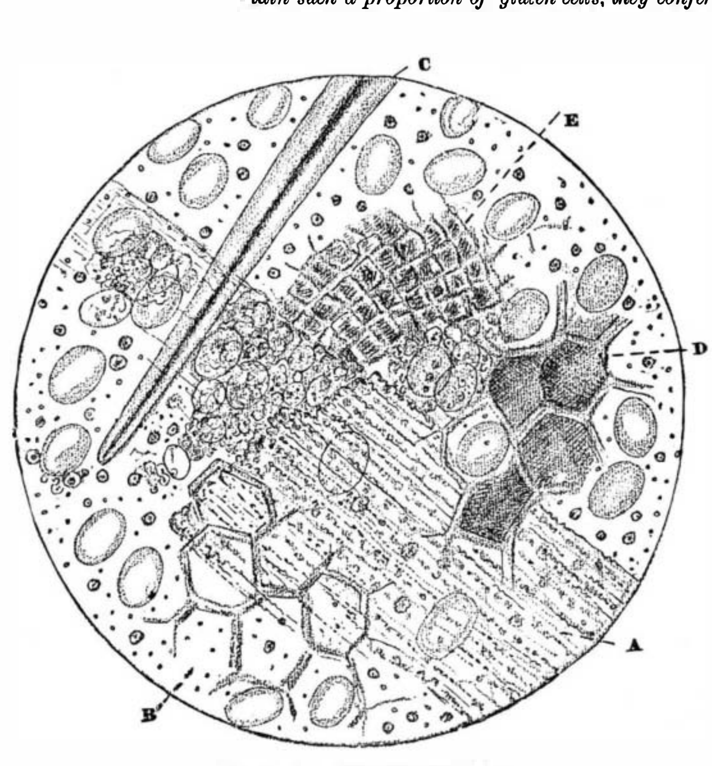

Fig. 12.—MELLIN'S FOOD

Fig. 12. Mellin's Food.—Segment of covering of the wheat grain, A; B, empty gluten cells; C, hair of the beard of wheat; D, gluten cells of wheat; E, collection of many gluten cells, not of wheat (note difference in shape of these cells and those marked B and D). Gluten cells readily found. Claims to be the only substitute for mother's milk, and not farinaceous. It is not polarized by light, save in a few starch grains scattered here and there. Starch is changed into a soluble form, so as to readily enter the circulation, on its introduction into a defectively digesting alimentary canal. *This food stands high on the list. Should the proprietors put in the full proportion of gluten cells it would be faultless. Magnified 800 diameters.*

Fig. 13. Gluten Flour, New York Health Food Co.—Claiming to be "almost no starch and all gluten." A, starch grains; B, fibrous tissue; C, starch granules. No gluten cells visible or to be found. *It cannot be distinguished from common flour.*

Fig. 14 Gluten Flour.—Many specimens examined by myself and Dr. G. B Harriman. of Boston, Mass. Masses of tegument and parenchyma, A; B, tegument; C, gluten cells—in repeated examinations about seventy were found; D, starch masses; E, connective tissue. This is a meal, and not a flour. The circulars are travesties, and show an ignorance which, if it did not affect human life, would be ridiculous. *Where only seventy gluten cells are found in a flour claimed to be all gluten, comment is unnecessary.*

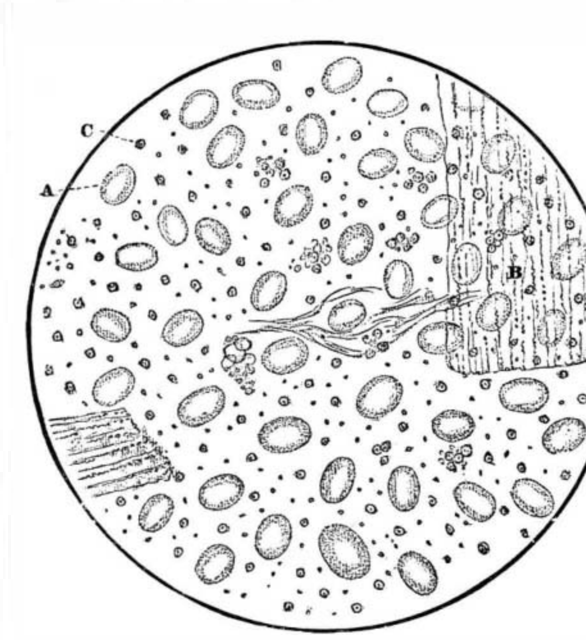

Fig. 13.—GLUTEN FLOUR.—N. Y. HEALTH FOOD CO.

Fig. 15. Fine Flour of the Entire Wheat, manufactured by the Franklin Mills Co., Lockport, N. Y., magnified 800 diameters. The field is filled with gluten cells, A; B, hairs of wheat; C, gluten comb coat.

Fig. 16. The Same Flour.—A, gluten cells; B, starch bundle; C, connective tissue; E, aleurone and gluten granules; G, giant starch grains. *Repeated examinations prove this to be the best flour examined. So long as the makers maintain such a proportion of gluten cells, they confer a blessing on mankind. It produces a light and spongy bread. It is a reliable infants' food.*

Fig. 17. Arlington Wheat Meal, magnified 800 diameters. A, tegument of wheat with gluten cells around and underneath; B, tegument, with no gluten cells; C, fibrous

tissue with contiguous starch cells and aleurone, and granular gluten in the interspaces. "Meal" is the product of a cereal ground coarsely, without bolting. Wheat thus ground is often called Graham flour, after Dr. Sylvester Graham, the noted vegetarian. A spurious Graham is wheat flour, mixed with bran. The Arlington is a pure Graham flour; rich in gluten and in all the elements of entire wheat.

Fig. 18. Crosby's Brain and Nerve Food, magnified 800 times. Claims to be composed of vitalized phosphates from ox brain and wheat germ. A, large mass of starch, obscuring the underlying starch, so large in some specimens as to occupy the whole field; B, ill-defined dark granular mass resembling gluten cell, though such an opinion is not warranted; C, similar masses; E, a gluten cell, possibly; D, apparently cooked animal substance. There are no characteristic gluten cells, no nerve fiber, no axis cylinder fiber, no ganglion nor multipolar cell. The advertisement claims that the brain is that of the ox, but the label states that the brain is that of the fish. Label admits 730 parts of starch in 1,000; claims some gluten. If this exists, it is the granular gluten of common flour. There are 270 parts of so-called vitalized salts asserted to be in this food; that is, salts formed in connection with the organic substances named. If this be so, all the albuminoids in all the foods herein described are vitalized also. There is but little gluten if any in this food.

Fig. 19. Blanchard's Glutena, magnified 800 diameters. Claims to contain 90 per cent. of gluten; starch only 10 per cent. A, large masses of starch, polarizes light beautifully, showing that the starch is not cooked or overheated; B, gluten cells. Gluten abundant; contains all the elements of wheat. *While there is gluten always found, this food contains 90 per cent. of starch, and only 10 of gluten—the reverse, exactly, of the claim made for the food.*

Blair's Wheat Food.—Well represented by Figure 9. *Abundance of free starch grains, giant, medium, and granular. No gluten cells.*

Fig. 20. Nestle's Milk Food; or, Lacteous Farina.—Magnified 800 diameters. A, masses of cooked starch; B, small granules of starch. Claims to be made of the best cow's milk. *It contains starch, and in the field there is an abundance of oil globules. There is milk in it and a quantity of starch, but no gluten cells.*

Fig. 21. Anglo-Swiss Food.—Magnified 800 times. A, starch cooked; B, oil globules; some gluten cells. *It is a milk food, with some gluten and cooked starch.*

Fig. 22. Baby Sop, Nos. 1, 2, and 3, magnified 800 times. A, large masses of oat gluten cells—notice how they differ in shape from the wheat gluten cells; B, starch bundles; C, granular starch. The three grades are prepared for infants of different ages: No. 1 for the youngest. This food is a malted preparation. Contains all the elements of the oat; an abundance of gluten. Starch grains much smaller than those of the wheat, and the gluten cells of characteristic shape This food is made of unhulled oats malted and crushed. See Figures 23 and 24. *Sustains its modest claims.*

Figures 23 A—23 B. The oat as found in examinations of Baby Sop.

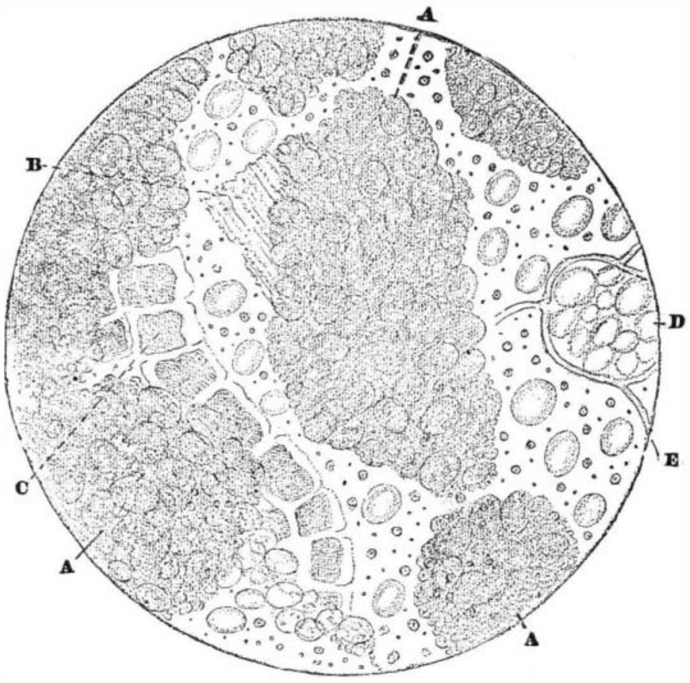

Fig. 14.—GLUTEN FLOUR.

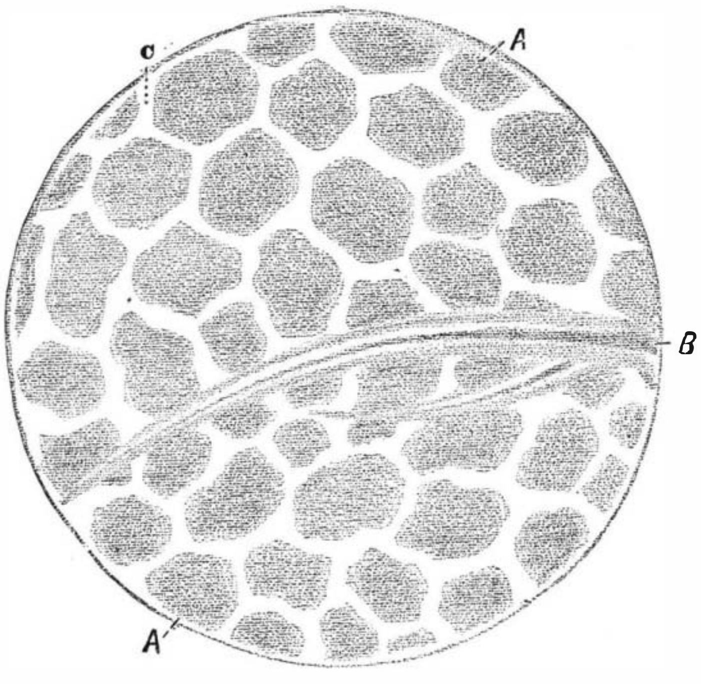

Fig. 15.—FRANKLIN MILLS ENTIRE WHEAT FLOUR.

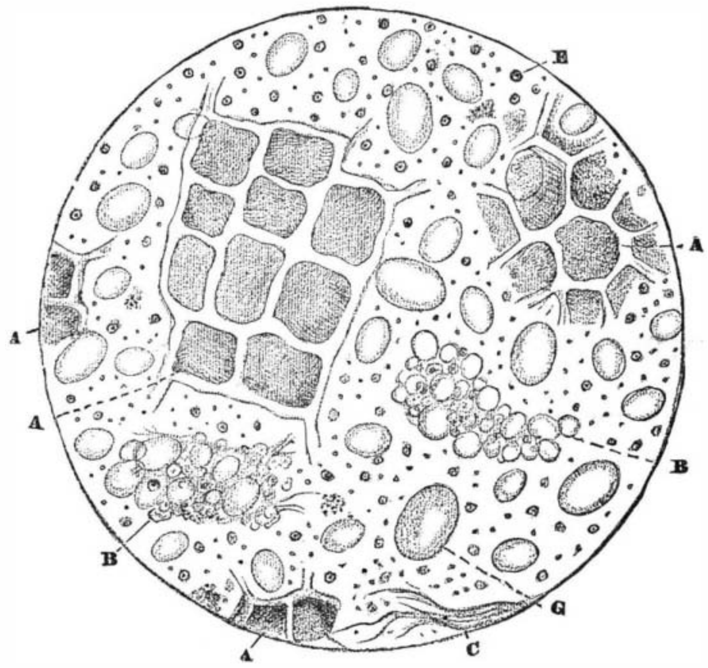

Fig. 16.—FRANKLIN MILLS ENTIRE WHEAT FLOUR.

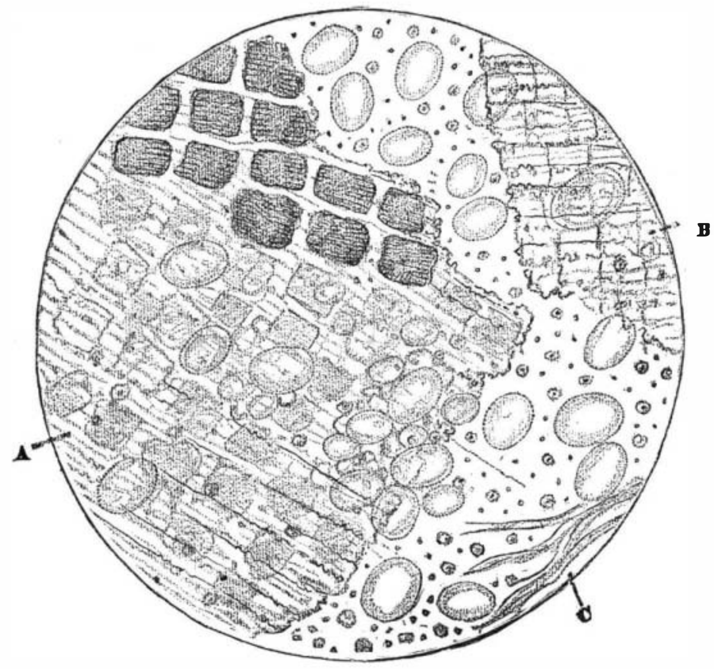

Fig. 17.—ARLINGTON WHEAT MEAL.

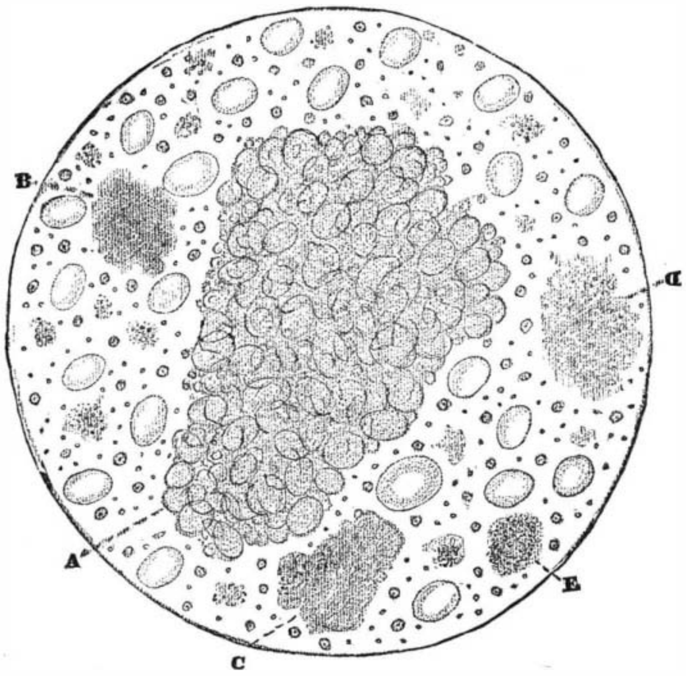

Fig. 18.—CROSBY'S BRAIN AND NERVE FOOD

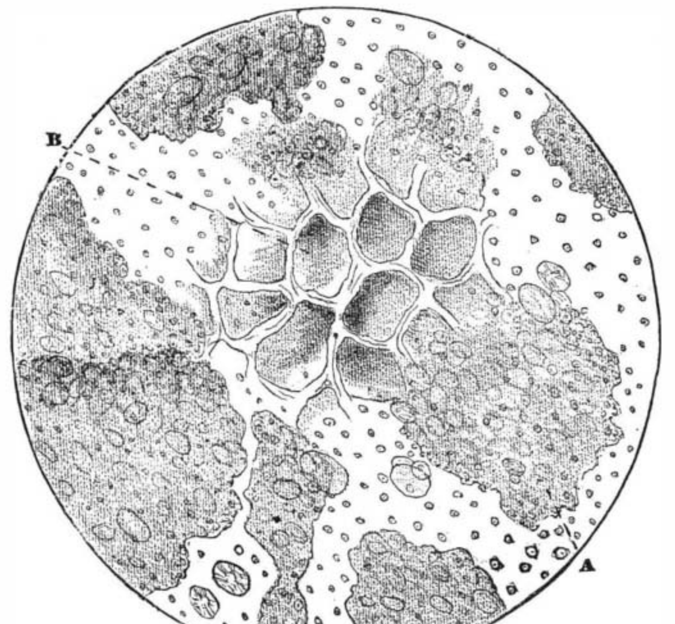

Fig. 19.—BLANCHARD'S GLUTENA.

Fig. 24. REDMOND'S CEREALINE, magnified 800 times. Polarizes light partially only. Made up of wheat starch grains. Bundles few. After many examinations a portion of tegument was found, containing all coats, and 50 gluten cells. *Claim of being economical (50 cents a pound), superiority to all other cereals, etc., not sustained.*

Fig. 25 DURKEE'S GLUTENA, magnified 800 times. A, masses of parenchyma of wheat grain, starch removed; here and there a strip of gluten cells outside. Beautiful starch grains and granular starch. *Figure 7 represents this food when crushed. Gluten cells not detected.*

FARWELL'S GLUTEN FLOUR.—Claims to be "gluten left behind after the starch is blown out." It required a long search to find any gluten cells. It is similar to the food last named, and Figure 25 is a good representation of it.

Fig. 26. VICTOR'S BABY FOOD, magnified 800 times. Claims "a close resemblance to mother's milk." A, large mass of cooked starch; B, starch grains deformed by cooking; C, broken starch cell; D, fibrous tissue, one gluten cell, occasional fat globules. Figure shows starch grains broken up into weird, irregular crescentic shapes, due to the mechanical crushing, after cooking. *It is like cracker and biscuit ground up.*

Fig. 27. BERMUDA ARROW ROOT STARCH, from the pure and genuine Bermuda arrow root, magnified 800 times.

Fig. 28. "The Pure Bermuda Arrow Root of Taylor Brothers." *Potato starch cells are here commingled with a few of arrow root; the adulteration is beautifully exposed, and the claim of purity is comical indeed. The manufacturers should examine these arrow root cells and their starch product under the microscope!*

MINNESOTA SURPRISE FLOUR.—This contains all the elements of the wheat, save *the gluten cells*. There is more granular gluten than is found in ordinary flour.

TRADE DOLLAR NEW PROCESS FLOUR, like the last.

HUBBELL'S PREPARED WHEAT.—Starch cooked, but not enough to prevent polarization of light; starch-bundles and aleurone. A few gluten cells. *Not up to its claim.*

MOTHER'S CEREAL MILK SUBSTITUTE.—The claim made shows that the manufacturers are profoundly ignorant of the mechanism, construction, and chemical elements of the cereals they describe and sell. Their language is not only unwarranted by scientific truth, but is absurd. They speak of "the chemical salts being separated by mechanical means," etc., etc.

Their preparation, nevertheless, is a good one, and contains more of the elements of wheat than was anticipated. It contains gluten cells, bundles of wheat starch, barley starch, and gluten granules.

HAWLEY'S LIEBIG'S FOOD.—Wheat gluten cells, barley gluten cells, barley tegument, wheat starch, cooked granular masses, not polarizing light. Well malted. *A good food, and its claims are sustained.*

THE FOLLOWING ADVERTISED FOOD STUFFS CONTAIN NO GLUTEN: Cold blast flour, N. Y. Food Co.; barley flour, do.; buckwheat flour, do.; India wheat flour; Lost Nation wheat flour; common Minnesota flour; Hazleton flour; Puritan flour; Patapsco flour; Underwood flour, fine granulated wheat flour (30 gluten cells); Gerber's food for infants and children (seems to be crackers ground)

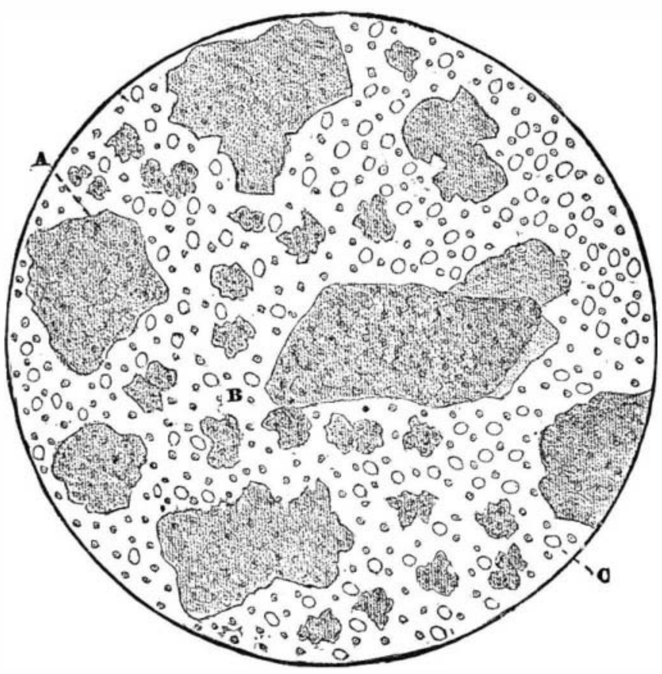

FIG. 20.—NESTLE'S MILK FOOD

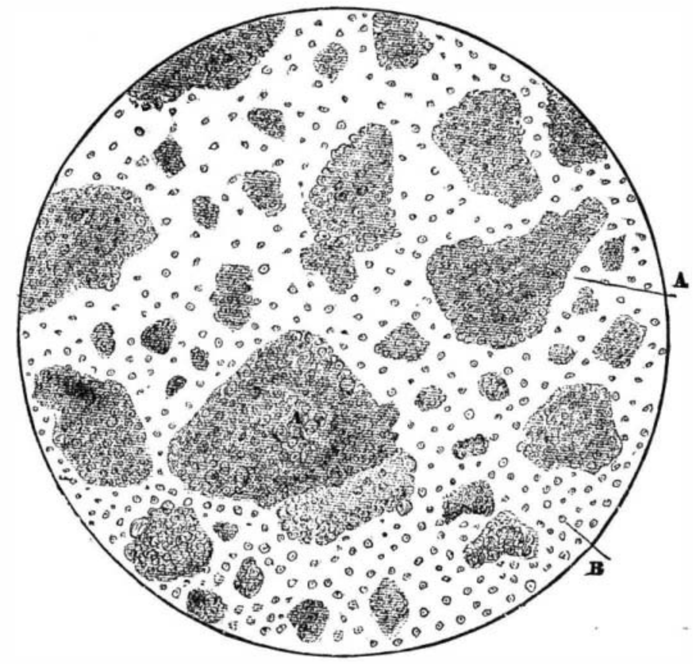

FIG. 21.—ANGLO-SWISS FOOD.

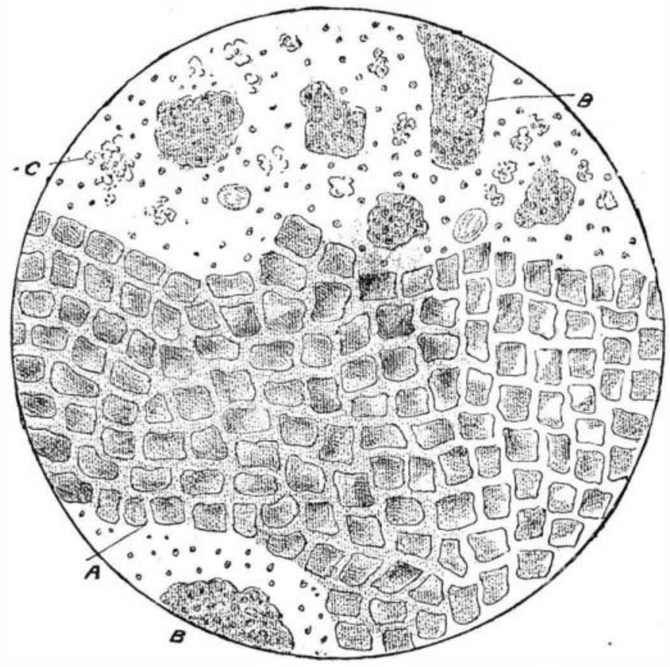

FIG. 22.—BABY SOP—NOS. 1, 2, AND 3.

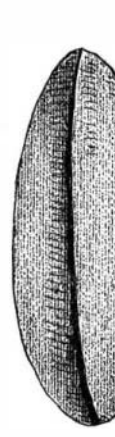
FIG. 23*a*.

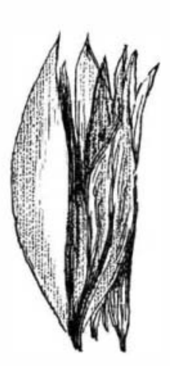
FIG. 23*b*.

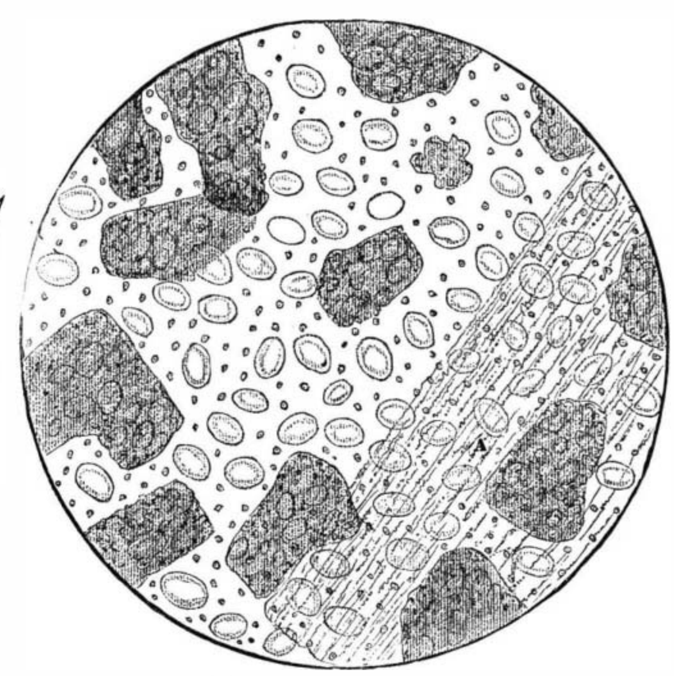

FIG. 24.—REDMOND'S CEREALINE.

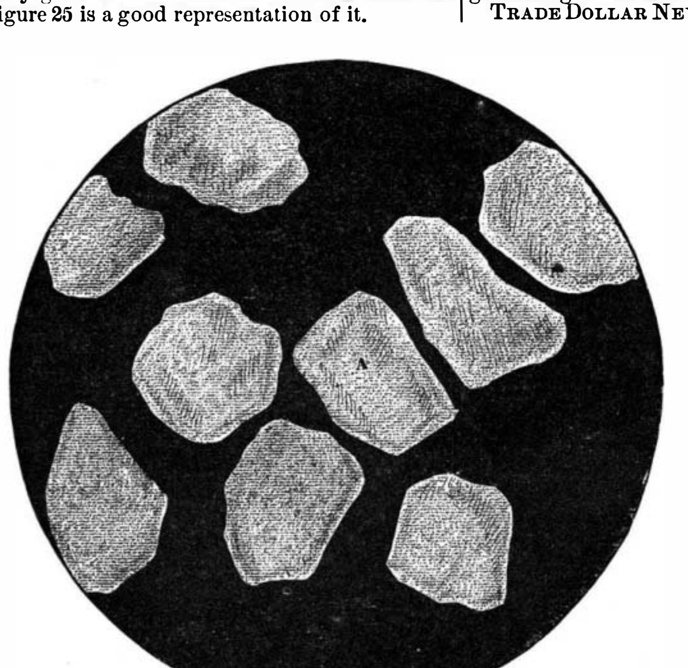

FIG. 25.—DURKEE'S GLUTENA

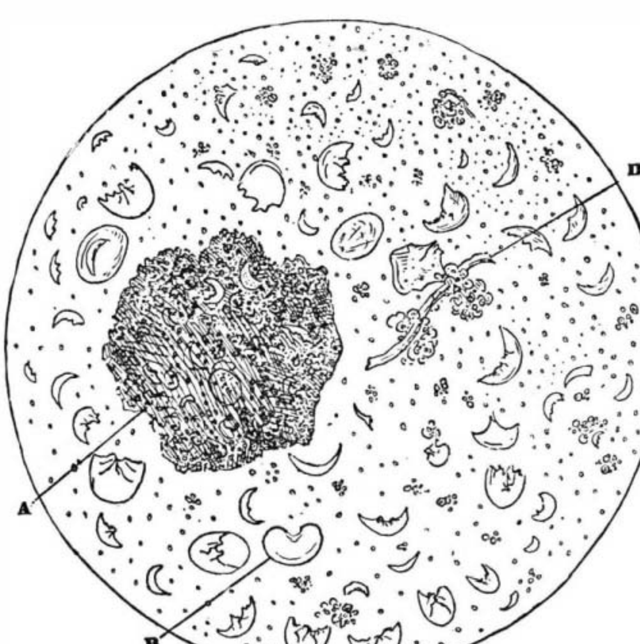

FIG. 26.—VICTOR'S BABY FOOD.